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TITLE: COOLING BODY

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ABSTRACT:

PROBLEM TO BE SOLVED: To provide a cooling body with wide applications by improving a refrigerant passage so that a cooling function by the cooling body with a limited volume can be enhanced.

SOLUTION: Cooling bodies 1 according to the present invention are cooling members 2 and 5 that are internally provided with a heat reception surface 20 for receiving heat from a heat-emitting member E (E1) to be cooled while the member E (E1) to be cooled is placed and a refrigerant passage 7 where a refrigerant R for absorbing transmission heat from the member E (E1) to be cooled being transferred via the heat reception surface 20 flows. In the refrigerant passage 7, channel parts a1 and a3 that are in parallel with the

heat reception surface 20 and channels a2 and a4 that are vertical to the heat
reception surface 20 are repeatedly and continuously formed.

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the cooling object which takes heat from the members for cooling (electronic parts etc.) generating heat efficiently, and can be used in order to cool.
[0002]
[Description of the Prior Art] Generally, since the member for cooling generating heat, for example, electronic parts, generates heat with energization, it is necessary to press them down to the temperature field to which the function does not fall.
[0003] For this reason, for example, heat transfer consists of good plate-like part material made from the quality of the material (aluminum, an aluminium alloy, copper), heat transfer receives heat in the heat-receiving side contacted to electronic parts directly or indirectly, and while taking heat and cooling, the cooling object which misses heat is used for the cooling water which flows and flows into a cooling water way. Moreover, various improvements are made also in the cooling water way inside said cooling object. For example, the cooling object (a cooling block) which circulates cooling water is proposed, circling in accordance with the spiral structure object which twisted, arranges and formed the metal tape in the interior arranged in parallel [in order to raise cooling effectiveness to JP,8-215737,A to the member for cooling generating heat] with the direction of two dimension along a heat-receiving side, such as a cooling way of a meandering configuration, and a cooling water way of a straight-line configuration.
[0004] In order to raise cooling effectiveness to the member for cooling generating heat, the cooling object which circulates cooling water in the cooling way of the meandering configuration arranged in parallel with the direction of two dimension along a heat-receiving side is proposed by JP,10-107194,A.
[0005]
[Problem(s) to be Solved by the Invention] According to the cooling object of said JP,10-107194,A and said JP,8-215737,A, the cooling water way of a meandering configuration is arranged in parallel with the direction of two dimension along a heat-receiving side, the flow rate of the cooling water which circulates a cooling water way is almost the same per unit area of a heat-receiving side, and an almost fixed cooling function is obtained in all the fields of a heat-receiving side.
[0006] However, when using as an object for cooling of electronic parts (for example, power component used for conversion with the direct current and alternating current in a current) with much calorific value for recent-years, for example, vehicle, loading, to improve a cooling function further is demanded.
[0007] Although lower cooling water temperature, a circulating water flow is increased or it is known here that it is effective to raise water pressure and to raise the rate of flow, in order to raise a cooling function under the conditions restricted since these conditions had various constraint, there is room of an improvement by the mounted module.
[0008] In addition, although a stirring operation is acquired and thermal conductivity can be improved by making it circulate, circling in the cooling water guided at the spiral structure object in the cooling water way of the meandering configuration arranged in parallel with the direction of two dimension along a heat-receiving side in the case of the cooling object of said JP,8-215737,A, the interior of a cooling object is not circulated in the thickness direction, and it is limited to circulation in the cooling

water way of a meandering configuration. Therefore, in order to raise a cooling function with the cooling object of the limited volume, there is room of an improvement.
[0009] This invention was made in view of said trouble, it improves a refrigerant path so that a cooling function with the cooling object of the limited volume can be raised, and it makes it a technical problem to offer the large cooling object of an application.
[0010]
[Means for Solving the Problem] It is the cooling member which equipped the interior with the refrigerant path where the refrigerant which takes the transfer heat from this member for cooling transmitted through the heat-receiving side and this heat-receiving side which the cooling object of this invention contacts the member for cooling generating heat, and receive heat from this member for cooling flows. This refrigerant path is characterized by forming the perpendicular passage section continuously repeatedly to the parallel passage section and this heat-receiving side to this heat-receiving side.
[0011]
[Embodiment of the Invention] According to the cooling object of this invention, said refrigerant path may make a straight line parallel to the heat-receiving side of a cooling object repeat and flow continuously the number of predetermined times as a three-dimensional revolution style made into a medial axis, when guiding a refrigerant.
[0012] That is, the count of predetermined, a repeat, and since it can show around continuously, said refrigerant path can expand the touch area of a cooling object and a refrigerant in the longitudinal direction of a cooling object, the cross direction, and the thickness direction for a refrigerant, it can raise cooling capacity, and can raise the cooling function per unit area of a heat-receiving side.
[0013] For this reason, the cooling object of this invention is excellent in the cooling function per unit area of the increase of the flow rate of the refrigerant per unit area of a heat-receiving side, and cooling capacity, and a heat-receiving side compared with the method which moves [meandering-] or moves [crookedness-] a refrigerant two-dimensional along the heat-receiving side in said conventional cooling object.
[0014] Said refrigerant path can consider the interior of said cooling member as spiral in the direction of three dimensions, or the configuration extended in the shape of meandering. In this case, since a refrigerant path is arranged in three dimensions in the cooling inside of the body (it arranges in the direction along the thickness direction and heat-receiving side of a cooling object), the whole volume of a cooling object can fully be utilized, there is no futility, and heat-of-cooling capacity can increase, and a cooling function can be raised compared with said conventional thing.
[0015] Namely, the refrigerant path should just be repeatedly extended in the so-called direction of three dimensions to the heat-receiving side.
[0016] A cooling object for example, by constituting by the 1st thick plate-like cooling member and 2nd thick plate-like cooling member which were divided into two By forming in the mating face of a 1st thick plate-like cooling member and a 2nd thick plate-like cooling member two or more crevices which carry out opening mutually and are open for free passage along a heat-receiving side, and opening each crevice of a 1st thick plate-like cooling member, and each crevice of a 2nd thick plate-like cooling member for free passage The interior of a cooling member can be formed as one refrigerant path extended in the direction of three dimensions. For this reason, it can manufacture by low cost.
[0017] It is formed so that it may circle in the straight line extended to a heat-receiving side and parallel inside a cooling object as a medial axis as a desirable configuration of said spiral refrigerant path, and the converging section which raises the rate of flow of a refrigerant to the part near a heat-receiving side is formed in the parallel passage section to the heat-receiving side.
[0018] A converging section can be made into about 1/2 - abbreviation 1/10 rather than the cross section of the passage section in which the converging section is not formed. In this case, the rate of flow of the passage section in which the converging section was formed becomes one about 10 times [twice / about / to] the speed of this compared with the passage section in which the converging section is not formed.
[0019] Said refrigerant path can be formed from two or more crevices which are open for free passage,

respectively by opening formed in the mating face of the thick plate-like part I material and thick plate-like part II material which were attached mutually.
[0020] Either said thick plate-like part I material or said thick plate-like part II material can use a thing with the heights which narrow the volume of a crevice of one of projections on another side of the crevice of thick plate-like part I material, or the crevice of thick plate-like part II material, and form said converging section in it.
[0021] tabular [which said thick plate-like part I material and said thick plate-like part II material are projected to the crevice of this thick plate-like part I material, or the crevice of thick plate-like part II material, shift, narrows the volume of that crevice, and forms said converging section] -- a core can be interposed.
[0022] fixing and holding with a bolt and a nut in the condition of having made the mating face with mutual said thick plate-like part I material and said thick plate-like part II material opening for free passage a part of each crevice which carries out opening in accordance with the location which counters -- or means, such as connecting in one by low attachment, can be used.
[0023] The cooling object of this invention is incorporated and used for the refrigerant circulatory system system which repeats the flowing refrigerant as a source of cooling, and uses it.
[0024] The cooling member which formed the crevice which forms said refrigerant path, respectively can reduce a manufacturing cost while mass-production nature is excellent by manufacturing for example, with die-casting shaping.
[0025] The system for engine coolant of the existing car and the system for electric motor cooling can be used that what is necessary is just to have a heat exchanger for taking heat from the member for cooling (for example, electronic-parts substrate) generating heat as said refrigerant circulatory system system, performing heat exchange to the refrigerant used as an elevated temperature, and giving a cooling function, and a feeding pump for carrying out circulation migration of the refrigerant.
[0026] The refrigerant path in the cooling object of this invention is formed in the interior by using as a cooling member two or more thick plates which consist of the quality of the material excellent in the heat transfer rate.
[0027] As the quality of the material excellent in the heat transfer rate, aluminum, an aluminium alloy, copper, a copper alloy, etc. can be used, for example.
[0028] A refrigerant path equips a cooling member with the inlet port and outlet which were formed in the heat-receiving side, the parallel direction, or the crossing direction. An inlet port and an outlet can be formed in the same end side [of a cooling member], or other end side side, or can be formed in another location. For example, an inlet port is formed in the end side of a cooling member, an outlet can be formed in the other end side of a cooling member, and an inlet port and an outlet can be formed in an end or other end side. Namely, a refrigerant path can be considered as spiral or the configuration of a method which goes to elongation and an one direction in the shape of meandering, and is open for free passage to the other end side outlet of a cooling member from the end side entrance of a cooling member in the direction of three dimensions inside a cooling member to a heat-receiving side.
[0029] From the point of an outward trip, it can go to the end side of a cooling member, and a refrigerant path can be considered as again spiral or the configuration of a method which is open for free passage to an elongation end side outlet in the shape of meandering by return while it forms spiral or the outward trip which goes to the other end side of elongation and a cooling member in the shape of meandering from the end side entrance of a cooling member in the direction of three dimensions inside a cooling member to a heat-receiving side.
[0030] At least one side of both sides (reaching on the other hand two flat surfaces of another side) to express can be used for a cooling object as a heat-receiving side.
[0031] Moreover, when using one side of said two flat surfaces as a heat-receiving side, for example, another side can be used into atmospheric air as a heat sinking plane which misses heat. As for said heat sinking plane, it is desirable to consider as the shape of the shape of a wave and toothing so that surface area can be increased in order to miss heat efficiently in atmospheric air.
[0032] Moreover, the shape of toothing can set up variously the difference of elevation for a concave part and the height, spacing, a number, etc. according to the purpose. As the shape of toothing, the shape

of surface type which arranged the slot, the protruding line, the hole (hollow), the projection, etc. to regular intervals and non-regular intervals at the array or the curled form can be used, for example.
[0033] When the quality of the materials of two or more cooling members which constitute said cooling object, for example are copper and a copper alloy as a refrigerant and the water for cooling and said quality of the material are aluminum and an aluminium alloy, the antifreezing solution for the engine coolant of a car etc. can be used.
[0034] It can have a converging section in the passage of said refrigerant path in the cooling object of this invention.
[0035] In this case, the rate of flow of a refrigerant increases with a converging section, and since the amount of contact per time amount of a refrigerant path internal surface and a refrigerant increases when it flows into the passage which is not a converging section from a converging section and a turbulent flow occurs, that the refrigerant flow rate per time amount increases, the cooling effect (temperature fall operation) of the heat-receiving side by the refrigerant can be heightened at this rate. And heat can be efficiently taken from the member for cooling in contact with a heat-receiving side (electronic-parts substrate), and cooling effectiveness can be raised.
[0036] To the heat-receiving side of a refrigerant path, although it is strictly parallel to the parallel passage section, the thing in the location which met the others and heat-receiving side mostly is included. For example, you may be what inclined a little to the heat-receiving side, the thing which curved a little.
[0037] To the heat-receiving side of a refrigerant path, although it is strictly perpendicular to the perpendicular passage section, the thing in the location which met in the direction which intersects an others and heat-receiving side mostly is included. For example, you may be the thing which inclined a little in the direction which crosses to a heat-receiving side, or the thing which curved a little. Moreover, as a means for increasing a touch area with the flowing refrigerant, a refrigerant path can form the irregularity of the shape for example, of a fold, or can make it the thing of the structure where have a branching path and a refrigerant branch besides a refrigerant main stream is obtained.
[0038]
[Example] (Example 1) The example 1 of the cooling object of this invention is carried by the car as a member for cooling based on drawing 1 - drawing 6 , and when taking heat and cooling through the electronic-parts substrate E1 (refer to drawing 1) which laid stability in the temperature field to which a function does not fall the electronic parts E which generate heat with energization, and laid two or more electronic parts E in order to hold, it applies and explains.
[0039] the thick plate-like part I material 2 which the cooling object 1 of the example 1 shown in drawing 1 - drawing 3 is a rectangle-like thing (set up in a longitudinal direction P, the cross direction W, and the thickness direction T as a predetermined value, respectively), and was attached mutually, and two cores -- it consists of a ** member 4 (refer to drawing 3) and thick plate-like part II material 5. In addition, the cooling object 1 is not limited in the shape of a rectangle, and can carry out setting possible to various configurations according to the purpose.
[0040] It is a thing made from an aluminum containing alloy, and a whole surface side is formed as a heat-receiving side 20 (refer to drawing 2 and drawing 3), and where the mating face 51 of the thick plate-like part II material 5 in which a side carries out a postscript on the other hand is contacted, the thick plate-like part I material 2 is stuck and is formed as a mating face 21 by which fixed maintenance is carried out.
[0041] Two or more crevices 3 of the predetermined depth h1 (refer to drawing 3) are formed in the direction which intersects perpendicularly with a longitudinal direction P as shown in the mating face 21 of the thick plate-like part I material 2 at drawing 4 at equal intervals along with a longitudinal direction P as 2 successive-installation eclipse, the 1st train crevice group 31, and a 2nd train crevice group 32 by the shape of a slot. Moreover, to the thick plate-like part I material 2, it sees from a flat-surface side, and has bolthole D in rectangle-like four corners.
[0042] A crevice 3 is the half-rate configuration (lower part configuration where the oblong circle was divided vertical 2 in parallel along with landscape orientation) of a cross-section abbreviation ellipse.
[0043] the core which carries out a postscript to the 1st train crevice group 31 and the 2nd train crevice

group 32 in the depth h2 shallower than the depth h1 of each crevice 3 -- the crevice 30 for positioning which functions in order to lay the ** member 4 in an orientation and to hold it is formed.
[0044] The crevice 30 for positioning is a cross-section configuration (refer to drawing 3) similar to the cross-section configuration of a crevice 3, and is open for free passage in elongation and each crevice 3 in the shape of a rectangle (refer to drawing 2 and drawing 4) in the direction (longitudinal direction P) which sees from a flat-surface side and crosses each crevice 3.
[0045] It is a thing made from an aluminum containing alloy, as shown in drawing 1 , and 2 and 3, a whole surface side is formed as two or more radiation fins 50, and after the side has, on the other hand, contacted the mating face 21 of the thick plate-like part I material 2, the thick plate-like part II material 5 is stuck and is formed as a mating face 51 by which fixed maintenance is carried out. Moreover, the thick plate-like part II material 5 is seen from a base side, and has bolthole D in rectangle-like four corners.
[0046] Two or more crevices 6 of the predetermined depth h3 (refer to drawing 3) are formed in the direction which intersects aslant the mating face 51 of the thick plate-like part II material 5 at a longitudinal direction P as shown in drawing 5 at equal intervals along with a longitudinal direction P as 2 successive-installation eclipse, the 1st train crevice group 61, and a 2nd train crevice group 63 by the shape of a slot. A crevice 6 is the half-rate configuration (upper part configuration where the oblong circle was divided vertical 2 in parallel along with landscape orientation) of a cross-section abbreviation ellipse.
[0047] the core which carries out a postscript to the 1st train crevice group 61 and the 2nd train crevice group 63 in the depth h4 shallower than the depth h3 of each crevice 6 -- the crevice 60 for positioning which functions in order to lay the ** member 4 in an orientation and to hold it is formed.
[0048] The crevice 60 for positioning is a cross-section configuration (refer to drawing 3) similar to the cross-section configuration of a crevice 6, and is open for free passage in elongation and each crevice 6 in the shape of a rectangle (refer to drawing 2 and drawing 5) in the direction (longitudinal direction P) which sees from a base side and crosses each crevice 60.
[0049] The inlet-port path 11 and the outlet path 12 of Refrigerant R which are open for free passage, respectively are established in the crevice 6 of the 1st train crevice group 61, and the crevice 6 of the 2nd train crevice group 63 at the end 5a side of the longitudinal direction P of the thick plate-like part II material 5. The crevice 62 for a free passage for opening the crevice 6 of the 1st train crevice group 61 and the crevice 6 of the 2nd train crevice group 63 for free passage is established in the other end 5b side of the longitudinal direction P of the thick plate-like part II material 5.
[0050] two cores -- the ** member 4 is the thing of the shape of a column (rod) to which it is a thing made from an aluminum containing alloy, and a cross section is extended along with the longitudinal direction P of an abbreviation ellipse form (oblong circle configuration). a core -- the ** member 4 has parallel inferior surface of tongue (whole surface) 41 and top face (on the other hand) 42 which counter in the thickness direction to the heat-receiving side 20, and the both sides of an inferior surface of tongue 41 and a top face 42 are formed as circular faces 43 and 43. a core -- the thickness t1 of the ** member 4 and the radius of curvature of circular faces 43 and 43 can be variously set up according to the purpose.
[0051] and the thick plate-like part I material 2 and the thick plate-like part II material 5 -- the crevices 30 and 60 for positioning -- a core -- while interposing a member 4, the rear face E11 of the electronic-parts substrate E1 which laid electronic parts E in the front face E10 is attached where the heat-receiving side 20 of the thick plate-like part I material 2 is contacted.
[0052] Fixed maintenance of this attachment is carried out with the nut N made to screw on the bolt T inserted in each bolthole D of the electronic-parts substrate E1, the thick plate-like part I material 2, and the thick plate-like part II material 6, and Bolt T (refer to drawing 2).
[0053] in addition, in either and another side of the mating face 21 of the thick plate-like part I material 2 attached as mentioned above, or the mating face 51 of the thick plate-like part II material 5 The sealant of the figure abbreviation fitted in the ring-like slot and ring-like slot on the figure abbreviation which enclose two or more crevices 3 or crevices 6 (conventionally) It is desirable to consider as the configuration using the gasket generally used, packing, an O ring, etc., or to interpose a sheet-like

sealant among mating faces 21 and 51, and to carry out a seal.
[0054] Thus, the spiral refrigerant path 7 is formed in the interior of the cooling object 1 of the constituted example 1 like drawing 6 shown in a frame Fig.
[0055] the spiral refrigerant path 7 -- two cores -- it is formed by the interconnecting catwalk 72 which opens for free passage ****** 71 and ****** 73 which progress the perimeter spirally centering on the straight-line shafts P1 and P2 (refer to drawing 6) formed by the ** members 4 and 4 (refer to drawing 3), and ****** 71 and ****** 73.
[0056] ****** 71 is formed in the 1st train crevice group 3 of said thick plate-like part I material 2, the 1st train crevice group 61 of said thick plate-like part II material 5, and the crevice 62 for a free passage for interconnecting-catwalk formation, and is open for free passage to the inlet-port path 11 of Refrigerant R.
[0057] ****** 73 is open for free passage to the outlet path 12 of Refrigerant R while it is formed by the 2nd train crevice group 32 of said thick plate-like part I material 2, and the 2nd train crevice group 63 of said thick plate-like part II material 5 and is open for free passage to ****** 71 with the refrigerant interconnecting catwalk 72.
[0058] ****** 71 and ****** 73, respectively by each crevice 3 of the thick plate-like part I material 2, and each crevice 6 of the thick plate-like part II material 5 The upper part inclination [which is extended ahead / slanting] parallel [it is parallel to the heat-receiving side 20 near the radiation fin 50, and] passage section a1, It serves as converging section S near the heat-receiving side 20, is formed between the lower part parallel passage section a3 parallel to the heat-receiving side 20, and the upper part inclination parallel passage section a1 and the lower part parallel passage section a3, and is formed to the heat-receiving side 20 in the almost perpendicular outside circular passage section a2 and the inside circular passage section a4.
[0059] the spacing d1 of the lower part parallel passage section a3 -- the inner base 31 of each crevice 3 of the thick plate-like part I material 2, and a core -- it is formed on the inferior surface of tongue (whole surface) 41 of the ** member 4. the spacing d2 of the upper part inclination parallel passage section a1 -- the base 61 in each [of the thick plate-like part II material 5] crevice 6, and a core -- it is formed on the top face (on the other hand) 42 of the ** member 4. And in order to form converging section S near the heat-receiving side 20, the lower part parallel passage section a3 is set up so that the lower part parallel passage section a3 and the upper part inclination parallel passage section a may become relation with the spacing d1< spacing d2.
[0060] Since it raises near the heat-receiving side 20 to the value aiming at the rate of flow of the flowing refrigerant R, the spacing d1 of said converging section S can be set up variously beforehand.
[0061] The upper part inclination parallel passage section a1 serves as arrangement extended in the slanting advance direction to the 1st medial axis P1 and the 2nd medial axis P2. The lower part parallel passage section a3 serves as arrangement extended in the direction which intersects perpendicularly with the 1st medial axis P1 and the 2nd medial axis P2 which are extended in parallel along a longitudinal direction P and the heat-receiving side 20.
[0062] It is included in the refrigerant circulator 8 of the refrigerant circulatory system system of a car, and the cooling object 1 constituted as mentioned above is used, as shown in drawing 1 .
[0063] The feeding path 81 which connects the refrigerant circulator 8 to the inlet-port path 11 of the cooling object 1, and supplies the refrigerant R with low temperature, The return path 82 which collects the refrigerants R with which it connected with the outlet path 12 of the cooling object 1, the cooling function was achieved, and temperature became high, It has the radiator (heat exchanger) 84 which lowers the temperature of the refrigerant R in the middle of returning to a pump 83 from the pump 83 which returns with the feeding path 81, is arranged between paths 82, pressurizes Refrigerant R, and is sent out to the cooling object 1, and the cooling object 1, and gives a cooling function. The antifreezing solution is used as a refrigerant R.
[0064] Hereafter, the busy condition of the cooling object 1 is explained.
[0065] Temperature is low, the refrigerant R sent out to the feeding path 81 from the pump 83 of the refrigerant circulator 8 has a high cooling function, and it flows into the spiral refrigerant path 7 from the inlet-port path 11 in the cooling object 1.

[0066] and the refrigerant R which flowed into the spiral refrigerant path 7 -- first -- the order of the upper part inclination parallel passage section a1 of ****** 71, the outside circular passage section a2, the lower part parallel passage section a3, and the inside circular passage section a4 -- a core -- many things moved forward circling in 360 degrees of the perimeter focusing on the axis P1 (refer to drawing 6) formed of the ** member 4 are spirally progressed with a repeat. That is, along with ****** 71, Refrigerant R repeats the cooling object 1 interior to the longitudinal direction P at the so-called three-dimensions longitudinal directions, such as slant, the direction of width-of-face W, and the direction (refer to drawing 1) of thickness T, and advances. It turns up from ****** 71 by the interconnecting catwalk 72. And in order of the upper part inclination parallel passage section a1 of ****** 73, the outside circular passage section a2, the lower part parallel passage section a3, and the inside circular passage section a4 a core -- with a repeat many things moved forward circling in 360 degrees of the perimeter focusing on the axis P2 (refer to drawing 6) formed of the ** member 4 While progressing spirally, and progressing to said three-dimensions longitudinal direction repeatedly and reaching the outlet path 12, after fully achieving a cooling function, it is collected from the outlet path 12 in the refrigerant circulator 8.

[0067] here according to the cooling object 1 of an example 1 -- the rate of flow of the refrigerant R in the spiral refrigerant path 7 -- a core -- it becomes quick in the most distant field in the direction of the outside of a radius from said core in an operation of the centrifugal force generated in the style of [of the refrigerant R which moves forward while circling in the parallel medial axes P1 and P2 as a core to the heat-receiving side 20 formed of the ** member 4] a spiral. And the effectiveness which makes the thermal boundary layer of heat transfer thin along with the internal surface of the most distant field from the direction of the outside of said radius of the spiral refrigerant path 7 can be demonstrated, and heat transfer effectiveness can be raised.

[0068] In the spiral refrigerant path 7, the cooling object 1 receives the parallel lower part parallel passage section a3 and the heat-receiving side 20 to the almost perpendicular outside circular passage section a2 and the heat-receiving side 20 to the parallel upper part inclination parallel passage section a1 and the heat-receiving side 20 to the heat-receiving side 20. Furthermore, in order with the almost perpendicular inside circular passage section a4 Since it is the thing which you repeat [thing] Refrigerant R and makes it flow in the direction of three dimensions in the cooling object 2 interior, the cooling object 1 whole can be cooled efficiently.

[0069] moreover, the lower part parallel passage section a3 of a part with the spiral refrigerant path 7 near the heat-receiving side 20 -- a core -- it is a configuration with converging section S which is narrowed by the bottom wall side 31, and is formed along the heat-receiving side 20 in the direction of width-of-face W of the cooling object 1, and raises the rate of flow of Refrigerant R among the inferior surface of tongue 41 of the ** member 4, and the crevice 3 of the thick plate-like part I material 2. For this reason, Refrigerant R has the rate of flow raised by converging section S in said each lower part parallel passage section a3 during a flow from the inlet-port path 11 to the outlet path 12 through said ****** 71 and ****** 73, and its flow rate per unit area of the heat-receiving side 20 increases. That is, the cooling function by the side of the heat-receiving side 20 improves compared with a thing without said converging section S.

[0070] Moreover, in much subregions in each outside circular passage section a2 in ****** 71 and ****** 73, and each inside circular passage section a4, Refrigerant R generates a turbulent flow, will be in the condition of having increased the flow rate per [which contacts] time amount with the cooling object 1 (contact surface area), raises the part and cooling function which increased, and carries out the temperature fall of the cooling object 1 whole. in addition, the number of the welding pressure according [the generating condition of the turbulent flow of Refrigerant R] to a pump 83, the volume of the spiral refrigerant path 7, a bore, a configuration, and flections, the magnitude of an R (radii), etc. -- the purpose -- responding -- those all -- or independence or combination can be set up variously.

[0071] Therefore, according to the cooling object 1 of an example 1, compared with the cooling object equipped with the refrigerant path arranged two-dimensional along said conventional heat-receiving side, it is the configuration which can increase the refrigerant path volume in the cooling object 1 interior. For this reason, the increase of cooling capacity with the cooling object 1, and at this rate, a

cooling function improves and it is useful in respect of practical use. Moreover, a radiation fin 50 functions as a radiator which radiates heat in atmospheric air.

[0072] Moreover, the thick plate-like part I material 2 and thick plate-like part II material 5 to which said cooling object 1 divided the complicated spiral refrigerant path 7 into two for the thick plate-like part I material 2 and the thick plate-like part II material 5 by die-casting golden die forming etc. that it can mass-produce, two cores -- since it can constitute only from combining three kinds of members of the ** members 4 and 4, it is easy to manufacture with simple structure, and low-cost-izing is possible.

[0073] In addition, in the case of said cooling object 1, the case where set the spacing d1 of the lower part parallel passage section a3 and the spacing d2 of the upper part inclination parallel passage section a1 as a different value, and it considered as the spacing d1< spacing d2 was shown, but it is not limited to this and many things can be set up. For example, when it considers as the spacing d1= spacing d2 and both are scolded, and when not extracting, or when it considers as the spacing d1> spacing d2, it can apply.

[0074] (Modification 1 of an example 1) Cooling object 1A (refer to drawing 7 and drawing 8) in the modification 1 of an example 1 Instead of the outside circular passage section a2 in ****** 71 and ****** 73 which form the spiral refrigerant path 7 of the cooling object 1 of an example 1, and the inside circular passage section a4 Are perpendicular to the heat-receiving side 20. To an upper limit and lower limit side The small R (radii)-like flection e Except having used spiral refrigerant path 7A (referring to drawing 8) of a configuration of having had ******71a and ****** 73a which can increase the conversion section of the flow which may generate the turbulent flow which considers as the outside perpendicular passage section a20 and the inside perpendicular passage section a40 in which e was formed, and contributes to the increment in the touch area of Refrigerant R and cooling object 1A It is the same as the configuration of the cooling object 1 of an example 1. Therefore, the same sign is given to the same component of an example 1, and the explanation is omitted.

[0075] Thick plate-like part I material 2A in which spiral refrigerant path 7A has crevice 3a of a cross-section configuration and crevice 30a for positioning in which four corners were formed in the small R (radii)-like rectangle (oblong) in the shape of half-segmented (lower part configuration where the oblong square was divided vertical 2 in parallel along with landscape orientation), Thick plate-like part II material 5A which has half-segmented crevice 6a (upper part configuration where the oblong square was divided vertical 2 in parallel along with landscape orientation), and crevice 60a for positioning for this rectangle (oblong), two cores of the cross-section configuration by which interposed between thick plate-like part I material 2A and thick plate-like part II material 5A, and four corners were formed in the small R (radii)-like rectangle (oblong) -- it is formed of the ** members 4a and 4a.

[0076] the refrigerant R which flowed into this spiral refrigerant path 7A -- first -- the order of the upper part inclination parallel passage section a1 of ****** 71a, the outside perpendicular passage section a20, the lower part parallel passage section a3, and the inside perpendicular passage section a40 -- a core -- many things moved forward circling in 360 degrees of that perimeter focusing on the axis P1 (refer to drawing 8) formed of the ** member 4 are spirally progressed with a repeat. That is, along with ****** 71a, Refrigerant R repeats the cooling object 1 interior to the longitudinal direction P at the so-called three-dimensions longitudinal directions, such as slant, the direction of width-of-face W, and the direction (refer to drawing 1) of thickness T, and advances.